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TRANSACTIONS OF THE ACADEMY . . . . . 91 to 100

32,500,000 motor vehicle registrations in the United States in 1941 (Last prewar year)

39,969 deaths from automotive accidents that year . . .

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To help awaken every driver to the need for regular visual examinations, Bausch & Lomb is publishing this advertisement in three of the country's leading magazines. In your community this message will reach hundreds of your potential patients. It will help remind them that your professional care *now* may save them and their families from such fatalities later. Another contribution by Bausch & Lomb to public understanding of professional visual care.

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What pitiful words: *"I didn't see!"* But so often that is the only cause for destruction of property and loss of life. Highway safety demands keen, alert, efficient vision; that's why many states require visual tests of applicants for drivers' licenses.

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Today, capable vision is necessary at work, at school, at home. In many progressive industries, modern techniques of visual analysis have resulted in improved quality and increased output of war materials, in added comfort and earnings for workers. Complete enjoyment of leisure hours requires comfortable, non-tiring vision.

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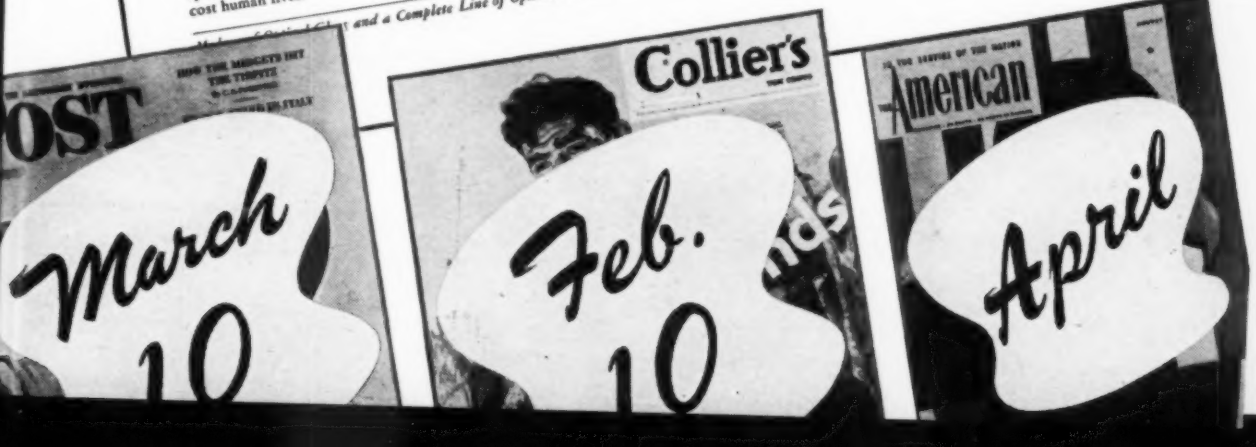

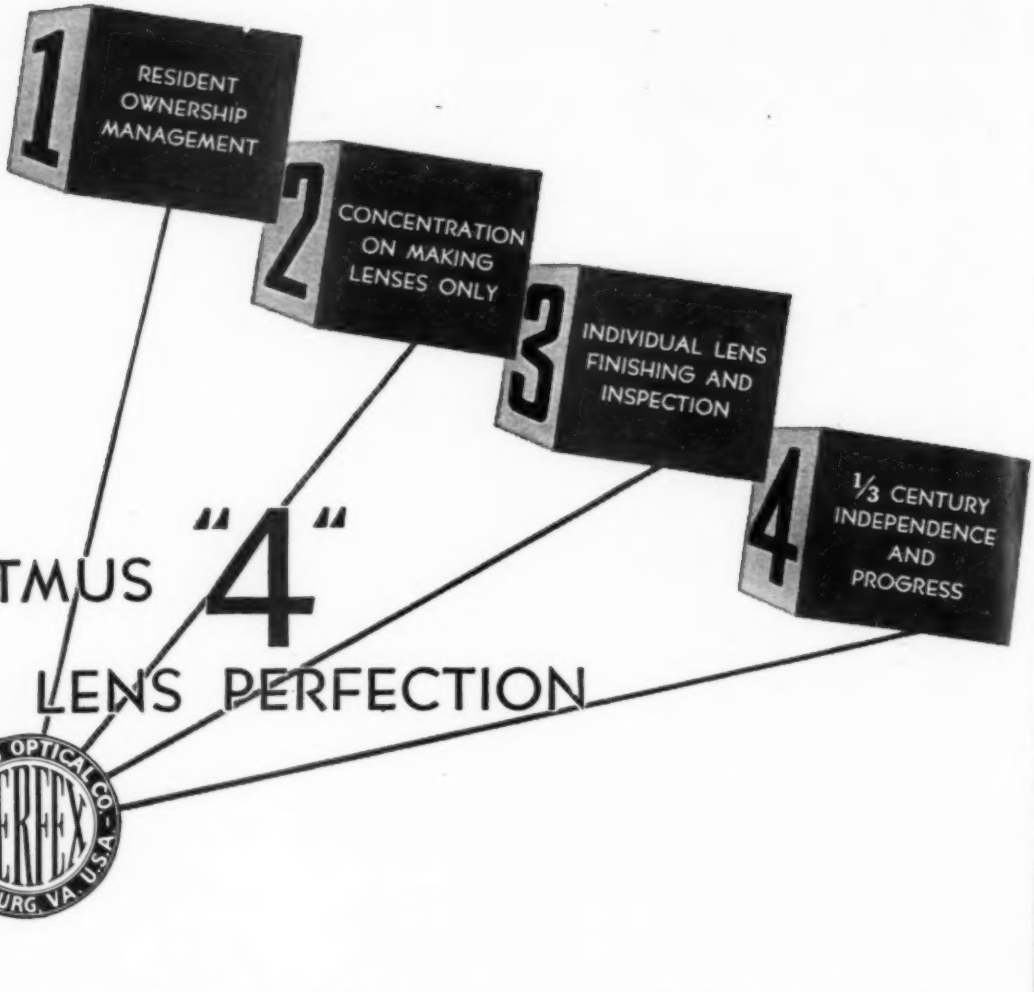

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As seen by NORMAL EYES
As seen by NEAR-SIGHTED EYES
WOMAN APPEARS CLEAR . . . BOY IS BLURRY
As seen by FAR-SIGHTED EYES
BOY APPEARS CLEAR . . . WOMAN IS DIM
As seen by AS-TIG-MA-TIC EYES
As seen by eyes with DOUBLE-VISION
BOTH BOY AND WOMAN LOOK "DOUBLE"
Can you believe your eyes?
Better Vision for Better Living

The "64 Dollar Question"...

"Can you believe your Eyes?" This challenging BVI advertisement skillfully directs the reader's eyes to visual demonstrations of the effects of common eye faults . . . shows how neglected vision can "play tricks" . . . tells *why* professional counsel and care alone can assure seeing that is *worthy of believing*. Oldsters and youngsters alike will be intrigued by this revealing advertisement. 40 million of them will have a chance to see it in the pages of Life, Sat. Eve. Post, Collier's, American, Farm Journal, and MacLean's—thanks to the generous support of the Institute's 3500 members, including: American Optical Co.; Bausch & Lomb Optical Co.; Bay State Optical Co.; The Kono Mfg. Co.; Frank Krementz Co.; Optical Products Co.; Shuron Optical Co., Inc.; Soft-Lite Lens Co., Inc.; Titmus Optical Co., Inc.; The Univis Lens Co.; Zylite Optical Co., Inc.

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Public Misconceptions —about Bats —about Glasses

BATS AREN'T BLIND
ACTUALLY THEY CAN SEE

GLASSES ALONE
CAN'T CORRECT FAULTY VISION

"Blind as a bat" is a common misconception. Bats have eyes and they can see.

People have a misconception about glasses, too. When their eyes trouble them, they often say: "Guess I'll have to buy some glasses." Actually, to think that glasses, alone, correct faulty vision is as wrong as to believe that bats are blind.

Glasses are important, of course, but your eye comfort and visual efficiency depend upon the professional and technical skill with which your eyes are examined and refracted; your glasses prescribed, your prescription interpreted, your glasses fitted, re-evaluated and serviced.

And remember, the fee you pay is for professional services. Many people mistake this fee for the price of a pair of glasses.

What really counts most, when your eyes need attention, is the professional skill and services of your Ophthalmologist, Optometrist, Ophthalmic Dispenser.

Remember, glasses alone can't correct f vision. Don't be satisfied with anything les thorough eye care.

Seek professional advice—not glasses at o

American Opt COMPANY

Founded in 1833 — the world's largest su to the ophthalmic professions.

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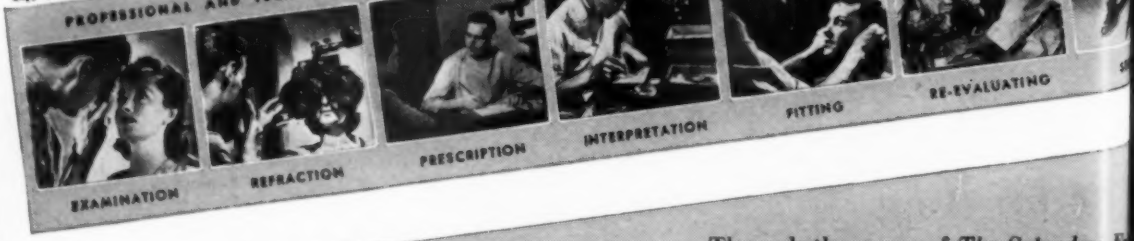
PROFESSIONAL AND TECHNICAL SERVICES ARE ESSENTIAL TO EYE COMFORT AND VISUAL EFFICIENCY—The AMERICAN



EXAMINATION · REFRACTION · PRESCRIPTION · INTERPRETATION · FITTING · RE-EVALUATING

Through the pages of *The Saturday E Life, Look,* and *Good Housekeeping,* th CAN Plan Educational Message wi circulation of close to 12 million. Po ers of these magazines total many m

And now the 4th year of AO's campaign

"Dedicated to the advancement of professional eyecare"

American Optical Company inaugurates the fourth year of its educational campaign with satisfaction in the progress made to date. Through educational advertising in national and other media this campaign is helping to correct the public misconception of the relation of spectacles to eye care and visual efficiency.

Real progress is evidenced in a more intelligent approach by some of the public in seeking eye care and solutions to their visual problems, and by their professional awareness to the need for better information about what constitutes true visual service. Also in evidence is the better orientation of the industry at large to the true character of the services rendered by those who consume the materials.

Original in its conception, persistent in its methods, this AO pioneering campaign dedicated exclusively to the advancement of professional eye care, continues to help pave the way for further progress.

Now, at the beginning of its fourth consecutive year, the American Optical Company campaign objectives to help correct the public misconception remain the same. But with the new year comes a new and fresh approach, an easily understood and convincing presentation of reasons why the public should seek professional advice — not glasses at a price.

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FOUNDED IN 1833—THE WORLD'S LARGEST SUPPLIERS TO THE OPHTHALMIC PROFESSIONS

One Sound Practice Builds Another

Prescribing quality and dependability has always been a sound practice. It is recognized as a sound practice builder as well, for successful refractionists have learned that only reliable prescription service fosters patient satisfaction.

Professional acceptance of Roco Rx Service is proof of its dependability. Customer confidence in Riggs-distributed Bausch & Lomb ophthalmic products is evidence of their quality.

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General Offices, Chicago, San Francisco
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AMERICAN JOURNAL OF OPTOMETRY
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Vol. 22 FEBRUARY, 1945 No. 2

FORCES BEHIND AN INDUSTRIAL VISION PROGRAM*

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The refractionist entering industry in his professional capacity may do so either on an in-plant or referral basis. He may be employed by a large company or may provide his services via his own office to one or more small organizations.

In any of these situations, or variations of them, he should be well informed in regard to the several agencies and groups which generally are as interested as he, himself, in industrial vision programs. Without this knowledge he may flounder on the shoals of misunderstanding and confusion. With it, he will be better equipped to develop his objectives, functions, and techniques.

It should be realized that variables of plant size, labor-management agreements, and departmental lines of responsibility may alter the factors under consideration considerably. However, there are certain basic patterns within any industry which are common to all.

The chart shown in Figure 1, will be helpful in presenting this subject:

Parenthetically, it should be understood that the refractionist occupies this central position on the chart on a purely subjective basis for the present discussion. Any of the other groups represented would occupy this hub position when considering their own specific problems.

Let us then review briefly each of the groups charted.

(1) *Management*

In this paper, a complete industrial vision program is considered as a combination of vision placement, correction, and protection.

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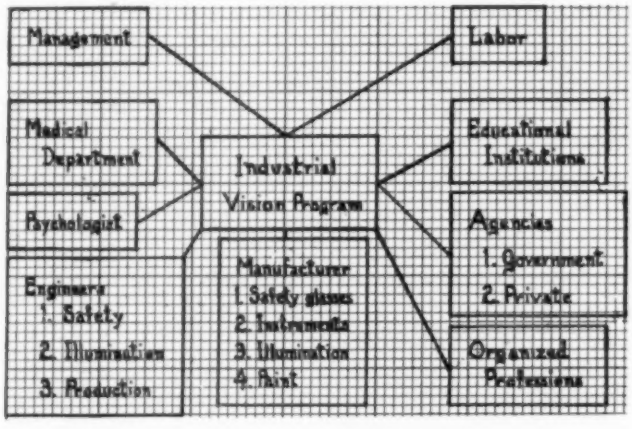
*An abridgment of the material presented before the American Academy of Optometry at Chicago, Illinois, December 11, 1944. For publication in the February, 1945, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY

It is obvious that if management were indifferent to the problems of vision in industry, the refractionist would be confronted with an immediate obstacle to these objectives. This barrier might not be completely insurmountable, since organized labor might demand his services, but his potential scope of activity would undoubtedly be severely curtailed.

Figure 1.



What then constitutes management?

Management is that part of an organization, which, as the name implies, directs or manages it. It may be composed of one or more individuals, depending on the size and organizational set-up. In a large organization, Management is divisible into several departments—Manufacturing, Sales, Industrial Relations, Finance, Research, etc.

In the larger industry, the responsible agent for management recommendation of a vision program might be the Medical Director, Safety Director, Personnel Director, or Industrial Relations Director. In the smaller industry, this agent of management may have a combination of functions. The refractionist has to be informed of the organizational chart in the particular company with which he wishes to be affiliated. It is quite possible that the recommendation for and subsequent direction of an industrial vision program might come from several or all of the above mentioned administrators. Representation from the Production Department likewise may be included as it is affected, also, benignly or adversely by an adequate or inadequate vision program.

So far we have dealt only with the immediate role of management. In a broader sense, management is interested in all health and protection programs (even the backward organizations are not unaware

of these), and frequently evaluate and re-evaluate such programs at meetings of the American Management Association, National Association of Manufacturers, and others. Further information is relayed to management through other professional organizations to which individual members of the company belong.

(2) *The Industrial Medical Department*

If the refractionist reports to this Department, it must be considered an extension of management. It is the speaker's belief that this is where the refractionist—whether employed or on panel system—should report. However, in some organizations, the refractionist is either independent or reports to the Safety or Personnel Director.

In any case, the cooperation between the optometrist and the Medical Department must be beyond reproach if the program is to succeed. The medical staff, including the staff of nurses, must be informed as to the refractionist's duties and functions. The consultant ophthalmologist whether within the company or outside of it, should be cooperated with fully. A program can not succeed without his services.

Through the medium of the American Association of Independent Physicians and Surgeons, the Industrial Hygiene Association, and other professional groups, the Medical Director, therefore, has a considerable influence in shaping professional and industrial thinking in regard to the efficiency of vision programs.

(3) *Engineering Departments*

There are three groups of engineers which either directly or indirectly are interested in vision. These are the Safety Engineer, Illumination Engineer, and the Methods Engineer. The first two obviously are concerned with seeing on the job, the last is less tangibly affected. Job efficiency is his concern and, of course, visual skills have their impact upon performance of work.

The National Safety Council, American Society of Mechanical Engineers, American Society of Safety Engineers, Illuminating Engineering Society, American Standards Association, and other engineering societies, are the representative organizations of these engineers.

(4) *Psychologist*

The psychologist in industry is frequently confined to the routine task of testing specific aptitudes by some standard procedure. However, in more advanced organizations the psychologist is allowed considerable latitude in order to uncover specific problems which are in or border on

his realm and for which he can make specific recommendations. Vision in industry is a case in point and the psychologist has made great contributions to the fund of knowledge of industrial seeing and its implications.

(5) *Labor*

There may or may not be a labor union in the particular company with which the refractionist affiliates himself. If there is, it is wise from the outset to acquaint the representatives of the union with the objectives and methods employed in carrying out the program. Their valuable assistance should be solicited from the outset preferably by management-union conference.

Organized labor is vitally concerned with the health and welfare of the employed. Its influence on programs dealing with vision in industry is made felt nationally, statewide, and locally, through efforts for legislation concerned with Workmen's Compensation, health care, and safety.

(6) *Organized Health Professions*

The American Medical Association, the American Association of Industrial Physicians and Surgeons, and the American Optometric Association, together with agencies (discussed under item 7) concerned with health and safety, all are becoming increasingly aware of the health needs of industry.

The American Medical Association and the American Academy of Ophthalmology and Otolargyngology has a Joint Committee on Industrial Vision, and the American Optometric Association likewise has a Committee on Industrial Relations. These committees are under the able leadership of Albert C. Snell, M.D. and R. M. Hall, O.D., respectively. Likewise, the Guild of Prescription Opticians has a Committee on Industrial Dispensing under the Chairmanship of Harry Davis.

All of these are concerned with (1) Education of its members for industrial activity; (2) Industrial Relations; (3) Standardization, and (4) Legislation.

Their influence is indeed extensive.

(7) *Professional Education Institution*

These both affect and are affected by industrial health and safety programs. They react to the demands of industry as well as frequently point up the problem together with suggestions to industry. Such institutions as Purdue University are leading the way toward a greater com-

prehension of industry's vision problems. The curricula of medical and optometric schools, as well as schools of personnel management, psychology, and engineering, are including more and more information on industrial health and safety. This, in turn, means greater emphasis on the visual problem in the latter group of schools mentioned above.

(8) *Agencies*

Agencies interested in eye care may be divided into two classifications: (1) Government, (2) Private.

Under the first classification we find the U. S. Department of Labor, Public Health Service, Office of Education, and others. Their interest may not be immediately apparent to the neophyte but it *is* present and their influence is weighty in matters of safety and health programs within industry.

The semi-private agencies like the Better Vision Institute, National Conservation Bureau, National Society for the Prevention of Blindness, American Medical Association, American Optometric Association, National Safety Council, Illuminating Engineering Society, all manifestly are deeply concerned with problems of safety and health and with vision programs which have placement-correction-protection objectives.

(9) *Manufacturers*

It is curious how frequently the professions of both medicine and optometry are affected by the attitudes of the manufacturers of materials and devices used by these professions. The manufacturers of paint, for example, have found a new market for his wares; namely, industry. Intelligently planned color painting on machines, walls, floors and ceilings has much to do with the visual comfort and safety and efficiency of the employee. It is not unnatural, therefore, that such manufacturers should become interested in safety programs.

In like manner, the manufacturer of illumination devices becomes interested in legal regulations pertaining to illumination, and the manufacturers of ophthalmic instruments and safety glasses become interested in safety, medical, and optometric programs in industry, in the professional man's education, and in proper legislation.

Summary

Fortunately all of these groups have a stimulating effect upon the industrial vision program in which the optometrist must assume his responsibility. Consciously or unconsciously for him, he is being guided toward becoming an ever more useful citizen. His need is felt, his re-

sponsibilities definitely are increasing, his reputation is growing, and the community at large is being benefited. What is more, he is realizing, as are the others about him, that the success or failure of his program in industry or in his community depends not on him alone but on the cooperative efforts of all concerned.

DR. RICHARD FEINBERG.
57 WEST 57TH ST.,
NEW YORK, N. Y.

AN UNUSUAL CASE OF ANISEIKONIA*

Meredith W. Morgan, Ph.D.
School of Optometry, University of California
Berkeley, Calif.

A report of a single case history cannot be used to prove or disprove any thesis in optometry. On the other hand, there are occasional single cases that should be reported because either they are illustrative of certain conditions or they are bizarre. This is the report of a case that is very unusual in nearly all of its aspects. It also serves to illustrate some methods of approach that are often neglected.

The patient, I. G., was referred to the clinic of the School of Optometry of the University of California for an Iseikonic examination by a Canadian ophthalmologist. "The above patient has been under my care for the past month regarding headaches. The headaches have been present for the past six years. They may be present in the morning, but get worse as the day progresses, frequently causing the patient to lose a night's rest. He has had frequent changes in lenses without help."

"Examination: Vision, right eye 20/200: left eye 20/20. Right eye corrected with approximately —4.50 to 20/20. Enclosed, please find a report on his eye muscle balance."

This report on his "eye muscle balance" was made by an orthoptic clinic, apparently run for the benefit of ophthalmologists of that community. Measurements were made with the aid of a Synoptophore, Maddox rod and by prism cover test. The results were: Date: 12/9/43

Exophoria minimum 8△
Exophoria maximum 14△
Left hyperphoria minimum 14△
Left hyperphoria maximum 19△
Adduction 20△/0△
Abduction 18△/0△
Right superduction 5△
No suppression
Excellent stereopsis
Near point of convergence 20 cms.

*Submitted on November 30, 1944, for publication in the February, 1945, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

Diagnosis: "Good fusion since he can easily overcome the left hyperphoria, but his convergence is poor. Weak right superior rectus."

These tests were made in December and orthoptic training was given for about two months with no noticeable decrease in symptoms, although there was significant improvement in the control of the extra-ocular muscles.

Since I. G. lived many miles from Berkeley it was my suggestion that two experiments be performed before advising him to make the long trip to Berkeley. The first was total occlusion of the right eye for a period of from three days to a week, and the second was that of wearing his full refractive correction with sufficient prism for him to have binocular vision with a red filter before one eye.

In a short time the report was returned to the effect that I. G. was very comfortable after the first day while wearing the patch over the right eye, but with the prisms the headaches were unbearable. With this information in mind, an Aniseikonic examination was recommended.

When I. G. arrived, he was not wearing lenses and stated that he was more comfortable without lenses than he was with any of the lenses that had been prescribed for him in the last six years. He had never known a really comfortable day for some time, suffering practically all the time from headaches, nausea, and dizziness. The symptoms were always greatly aggravated by the use of his eyes and so he felt sure that they were ocular in origin. He had had many physical examinations as well as many eye examinations, during the last six years. All the physical examinations had been negative. The refractions had resulted in ten pairs of lenses, none of which he could wear with any satisfaction. The prescriptions of these lenses are given in Chart 1. The reader will, no doubt, note the very slight changes made in the prescriptions and the almost complete lack of attention to the vertical deviation.

Date	Doctor	Prescription	
		Right	Left
8-23-36	McA.	—4.50 = —0.50 ax 90° 2△ Base-in	—0.50 ax 90° 2△Base-down
11-16-38	D.	—4.00 = —0.50 ax 90° 2△ Base-in Add +1.50	+0.25 = —0.50 ax 90° 1½△ Base-down Add +1.50
3-17-39	X. Cl	—3.75 = —0.75 ax 80° Add +1.00	+0.25 = —0.50 ax 90° Add +1.00

5-20-41	B.	—3.50 = —1.00 ax 60° ¾ △ Base-up	+0.50 = —0.50 ax 90°
10-6-41	B.	—3.50 = —1.00 ax 60° 1½ △ Base-up	+0.50 = —0.50 ax 90°
7-27-42	B.	—4.00 = —0.50 ax 75° 2△ Base-up Add +1.50	—0.25 ax 60° 2△Base-down Add +1.50
11-6-42	E.	—4.00 = —0.50 ax 75°	—0.25 ax 60°
11-6-42	E.	—2.50 = —0.50 ax 75°	+1.50 = —0.25 ax 60°
5-12-43	E.	—4.00 = —0.50 ax 65° Add +1.50	—0.25 ax 60° Add +1.50
1-4-44	McM.	mottled	—0.25 ax 60° Add +1.50

Chart 1.

Without lenses I. G. had a definite tropia with the right eye deviating out and down. By covering the left eye and then uncovering the same eye the deviation was found to be by neutralization, 5△ exotropia and 2△ right hypotropia.

The results of refraction are shown below:

Static Skiametry	R. —3.75 = —0.50 axis 90°	
	L. +0.75 = —0.25 axis 90°	
Subjective	R. —3.50 = —1.00 axis 75°	20/20
	L. +0.75 = —0.75 axis 90°	20/20
	6△ Exophoria by dissociation.	
	2△ Left hyperphoria by dissociation.	
Adduction	28△/12△	
Abduction	9△/5△	
Supraduction	Right 4△/2△	Left 4△/2△
Infraduction	Right 3△/1△	Left 4△/2△
Monocular Cross Cylinder	R. —1.25 = —1.00 axis 75°	
	L. +3.00 = —0.75 axis 90°	
Binocular Cross Cylinder	R. —2.00 = —1.00 axis 75°	
	L. +2.25 = —0.75 axis 90°	

Following tests made through +1.50 add

Supplementary Fusional Convergence	—3△	
Positive Fusional Reserve		21△/13△
Negative Fusional Reserve		24△/16△
Accommodative Amplitude	R. 2.0 D	
Accommodative Amplitude	L. 2.0 D	

Positive Relative Accommodation —1.00 D
Negative Relative Accommodation +1.00 D
Dynamic Skiametry R. —1.75 = —1.00 axis 75°
Dynamic Skiametry L. +2.50 = —0.75 axis 90°
By cover test with subjective the deviation neutralized was:
12△ exophoria
5△ left hyperphoria

Absolutely no evidence of suppression. Stereopsis good. With red and green filters before the eyes, fuses without prism help.

When a subject who has poor fusion is examined for aniseikonia, great difficulty is usually encountered in maintaining fusion since the fusion mass of the target of the Eikonometer is seen peripherally. Sometimes this tendency toward diplopia can be overcome by changing the polaroid filters eye for eye, but generally when there is a hyperphoria of any amount, prisms must be used. However, during the aniseikonic examination I. G. had no difficulty at all in maintaining fusion. This again emphasizes his strong fusion faculty.

The aniseikonic examination revealed that the image as seen by the right eye was some 4% smaller overall than that seen by the left eye. The sensitivity was ±0.25% in the vertical meridian and ±0.5% in the horizontal

The following lenses were prescribed:
R. —3.50 D.S. = —1.00 D.C. axis 75° = 4% M.o.a.
L. +0.75 D.S. = —0.75 D.C. axis 90°
Add +1.50 D.S. in Fulvue bifocal

This correction was made up in bifocals in spite of the rather obvious disadvantages due to the anisometropia. When the visual lines pass through a point 8 mm. below the center of these lines, there is an effect of approximately 3.5△ base-down before the right eye, just in the reverse direction of any prism that might be prescribed. These lenses were made in bifocals because of their obvious advantage in the patient's work. A slab-off prism might have been incorporated except for the fact that this would have changed the magnification ratio.

After wearing these lenses for a little more than a month, I. G. has reported almost complete relief from all subjective symptoms. His ophthalmologist writes: "He feels very comfortable, in fact, has never felt so comfortable for years."

This particular case has many interesting aspects, both as to the nature of the subject's difficulty and to the methods pursued by both

optometrists and ophthalmologists in an attempt to solve the difficulty. Some information may be gained by looking at the record of the many prescriptions given him as reported in Chart 1. First of all it is to be noted that the lenses prescribed by Dr. McA. in 1936 had prisms base-in and base-down, which indicates that the exophoria and hyperphoria existed to appreciable degrees even at that time. I. G. wore these lenses for little more than two years. This would indicate that his symptoms were not too severe at that time or he would have had his eyes examined sooner. The next prescription is essentially the same as the first except for the fact that they were bifocals. These lenses were worn only four months. It will then be noted that no other prescription contains base-in prisms in spite of the fact that there is a very high exophoria associated with extremely poor convergence.

The main surprise of the whole case history, however, is the fact that no one ever suggested that one eye be occluded for any length of time nor did anyone try the experiment of giving any degree of prism power to find the patient's reaction to these lenses. These two omissions in technique are very serious in my opinion. Here is a patient with very serious difficulties. He has anisometropia, a high exophoria, a rather high hyperphoria and to top it off he is presbyopic. Now the question at once would seem to be which one of these factors forms the basic difficulty? Perhaps it is some combination of these factors that is causing the complaints. Yet none of the optometrists nor the ophthalmologists had attempted to find the basis for the complaints so that a more intelligent solution might be found.

Total occlusion of one eye eliminates, of course, all three factors of anisometropia, exophoria, and hyperphoria. When this was done, it was found that nearly all symptoms were alleviated. Hence, the headaches are of ocular origin and are associated with binocular vision. When prisms were worn, thus at least partially eliminating the exophoria and the hyperphoria, the symptoms were markedly increased. This means, then, that these factors are not at the basis of the difficulty. It would then be logical for the average practitioner, not having an Eikonometer available, to assume that the difficulty is associated in some way with the anisometropia. Then, the next step would have been to make his lenses so that the right or more concave lens was ground on a deep base curve and the left or more convex lens was ground on a flat base curve.

This procedure as outlined above would have been a very definite aid to the patient and done more to solve his visual problems than pre-

scribing just another pair of lenses, not vastly different than the one before.

The nature of the refractive error in this case may be surmised from the data. It has been shown by Knapp (1) that in an axial ametropic eye, corrected by an ophthalmic lens whose second principal plane coincides with the anterior focal point of the eye, the size of the retinal image is the same as though the eye were emmetropic. Thus, in cases of anisometropia due to axial ametropia there should be no difference in the retinal image sizes and hence there would be no aniseikonia. Of course, few ophthalmic lenses are fitted as far in advance of the eye as the primary focal plane and hence one of the conditions of Knapp's law is not ideally fulfilled. However, the departure from this condition is generally not so great as to vitiate this rule to any extent. Therefore, in corrected axial ametropia it is safe to assume that the size of the image on the retina is nearly the same as though the eye were emmetropic, and in cases of anisometropia where the ametropia is due to improper axial length there would be no difference in image sizes between the two eyes.

On the other hand, when the ametropia is not axial but refractive, the size of the image on the retina is proportional to the ametropia when correction lenses are worn. This refractive ametropia may be due to the refractive power of the cornea or lens or both. It may also be due to the index of refraction of the different media of the eye.

This change in image size in corrected ametropia of the refractive type approximates very closely 1.7% per diopter. (2) The image is reduced in myopia and enlarged in hypermetropia.

Now, in the case of I. G. discussed in this paper, the ametropia was corrected by:

R. —4.50 D.S. = +1.00 D.C.
L. 0.00 D.S. = +0.75 D.C.

While there is a slight difference in the astigmatism, it is too small to be of any consequence. Thus, the difference in refraction is entirely in the spherical element. If this ametropia is axial in nature, then there should be no difference in the retinal image sizes due to the anisometropia. On the other hand, if the ametropia is refractive in nature, then the image as seen by the right eye should be approximately 7.5% smaller than that seen by the left eye. Actually, however, the measured difference between the two eyes was only 4.0%. This means that if the aniseikonia is due to the anisometropia the ametropia cannot be purely axial or purely refractive, but it must be of the mixed variety.

This report has been made with the hope that it will encourage more optometrists to accept difficult cases as research problems and that no attempt be made on such cases to write a final prescription on just a single refraction.

The references list some of the more important contributions relating to the subject of aniseikonia as well as those applying directly to this article.

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INTELLIGENT GUESSING*

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It has been said that no one in any other field ever encounters as much sales resistance as a college professor. It is an open scandal that education is bought like castor oil, and seems to be about as hard to take. The student knows that he cannot do without it, but he keeps the bottle tightly corked except in emergencies, and he resists instinctively and effectively every effort that is made by his teachers to increase the quantity and frequency of the dose.

Assuming that such a student is a reasonable person, as he may well be, then either he is simply lazy, in which case we are not further concerned with him here, or he is serious-minded about getting his education, but is handicapped because he doesn't quite know what it is that he is trying to get, or what it is supposed to do for him, or how he is supposed to get it. In short, he is handicapped by a set of fundamental misconceptions about the nature and purpose and method of education. Among his misconceptions are the following:

1. That education is something which his teacher can *give* to him, his own role being that of a purely passive receiver.

2. That there is only a limited amount of room in his mind, so that if he tries to learn too much, something else which he has already learned will be crowded out.

3. That he is working for the teacher instead of for himself.

4. That in order to solve an intellectual problem, he must have a previously learned formula or rule which he can apply mechanically to get the right answer.

5. That he should never do any guessing except to cover up faulty knowledge.

Guided by his first misconception, the student fills his notebooks with his teacher's words, and by sheer memorizing, soaks up as many of them as the discipline of the class compels him to. He does not realize that the function of a teacher is not merely that of presenting a simplified paraphrase of a text book, but more important, that of being pro-

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vocative—that his words are meant to be sparks with which to explode a few cells in the student's own brain. It is one of the major tragedies of our educational systems that too often the teacher himself does not realize this. Instead, he encourages his students to revere him as an oracle and to treasure his wisdom, his most successful students being the ones that are the best parrots.

Some professors, however, are educators rather than merely instructors, in the root senses of these terms, and the average student will probably have had courses from some of them during the time that he is accumulating the credits which he exchanges for his diploma. These men make their students rather unhappy. In a Socratic fashion, they try to unsettle the student's faith in the infallibility of text books and teachers and of the knowledge that he has so painfully acquired from them both. They entreat him to think things through for himself, but they succeed only in baffling and confusing him. In the end, the student finds these educators to be much more provoking than provocative, and he turns with relief to his other instructors who decently enough furnish him with text books and lectures in which are contained exactly the answers that he is held responsible for in their courses.

The implications of his second misconception, that there is a limited amount of room in his mind, and of his third misconception, that he is working primarily for his teacher, overlap considerably. As a result of these misconceptions, he is careful never to "learn" anything unless he is quite sure that it is necessary for him to do so, and that he is not doing any more than was specifically required of him. He considers necessary work to be work about which questions are asked on his examinations, and assignments become formulas for eliminating all unnecessary work. Having "learned" the facts and formulas of his assignments, he stores them away in separate compartments of his notebooks and his mind, where they are buried until eventually most of them are lost or forgotten. In the language of Alfred North Whitehead, they remain "inert ideas." These are ideas which, as Whitehead explains, are received into the mind, but are never tested, or used, or combined with any other ideas. Inert ideas do not evoke any curiosity, or judgment; they do not contribute to the mastery of complex circumstances; nor do they afford any aid in furnishing the theory for giving foresight in special cases.

If Whitehead's viewpoint is accepted, it is self-evident that the crucial phase of education begins after the lessons in the text have been learned. It is equally self-evident that a student whose schooling is

vitiated by the misconceptions enumerated above will never gain more than a rudimentary and primitive education, inasmuch as his ability to work out independently problems in which his interest is awakened will remain for the most part undeveloped.

The student's fourth misconception, that he must have a formula or rule which he can apply mechanically before he can solve an intellectual problem, impels him to place too much reliance on his memory and not enough on his intelligence. Consequently, even where his formulas or his memorized scraps of information are relevant, a slight lapse of his memory may prove to be disastrous. But even more important is his helplessness in a situation where either he has no ready-made formula, or he does not know which one to use. There are no formulas for creating formulas, any more than there are any formulas for determining which formula is relevant for the solution of a given problem. When used intelligently, formulas are convenient for solving problems with a minimum amount of mental exertion—but, like the premises of a syllogism, they do not guarantee their own truth, and can easily become booby traps for the unintelligent.

The student's fifth misconception is that "guessing" is an illegitimate practice which is used only to cover up faulty knowledge. As the result of this misconception, he rarely guesses except when he knows that he should not be doing so. Consequently he thinks for himself as little as possible. It is this misconception which is responsible for the most serious aspect of the student's resistance to education—the fostering of a sort of intellectual laziness, which restrains the student from doing any thinking for himself, i.e., any intelligent guessing.

To teach students how to guess intelligently and how to evaluate guesses critically is one of the major purposes of education. It has often been said that the aim of education is to teach students independence of thought, or originality, or how to use facts, or how to think for themselves, or how to think critically, or how to exercise their own judgment, etc.; but none of these aims can ever be achieved by anyone who has not learned how to guess intelligently, and how to criticize his own guesses.

A "guess" is well defined by Funk and Wagnalls as "a swift conclusion from data directly at hand and held as probable or tentative, while one confessedly lacks material for certainty." Concerning matters of *fact*, guessing can never be anything but stupid. No deficiency in our knowledge of facts can ever be bridged intelligently by guessing. No

matter how brilliant a student or an observer may be, he must accept and learn facts exactly as they are given. In the pursuit of truth, it is as deadly a sin to guess about facts as it would be to deliberately misrepresent them. Education, therefore, begins with the faithful and literal learning of facts; and one of the cardinal principles of education is that in the realm of facts, guessing is taboo.

For practical purposes, and particularly for the student who is told to learn "the facts" as the first step in the educational process, we may tentatively acknowledge as a "fact", any statement which is accepted as true by the experts in the appropriate field. As the educational process continues, the student must outgrow this rule of thumb guide, which breaks down when he raises questions concerning the criteria by means of which we can determine what field to go to, or who the experts are in that field, or how we can choose between them when they disagree.

In a broader sense, a fact may be defined as a description of reality which is strictly true. Thus the meaning of factuality is determined by the meaning of truth and reality, and the nature of the knowing process; and a searching investigation of the meaning of "fact" would constitute a system of metaphysics and a theory of epistemology. For the limited purposes of this paper, it will be sufficient to point out that from the point of view of the educator, facts are data which are learned to be true by *discovery*—either by the senses, or by the mind. Thus there are two broad realms of fact—empirical facts, or knowledge discovered through the senses; and rational facts, or knowledge discovered by the mind (such as the concepts and principles of mathematics).

We have said that education begins with the faithful and literal learning of facts. But it does not stop there. Facts are useless and inert until they are understood, and interpreted, and applied to human experience; and this breathing of life into dead facts is not done by learning more facts. It can be accomplished only by a creative activity of the mind, for which, perhaps because it is so rare, we have no satisfactory name. Such terms as native intelligence, braininess, the power of original thinking, quick-wittedness, resourcefulness, "I. Q.," good judgment, etc., have been used to designate the special talent of creativity and originality and judgment possessed by the human mind. The excellence of the development of this special talent can be measured quite accurately by the quality of the intelligence revealed in making guesses, that is, in formulating non-factual judgments based upon facts.

As the great eighteenth century philosopher, Immanuel Kant,

pointed out, deficiency in this talent is what we call stupidity; and stupidity is one of the things for which we still have no remedy. Kant remarks that a narrow and stupid mind may be improved by study so far as to become even very learned, and that a teacher may succeed in transplanting into a stupid pupil's understanding plenty of beautiful rules borrowed from the experience of others. But no teacher can implant into a stupid mind a native mental endowment which the pupil does not possess; and a stupid mind, no matter how learned and crammed with facts and rules it may become, will inevitably betray its inherent deficiency.

Faulty education is responsible for far more learned fools than is defective mental endowment. The "doctorae ignorantae" flourished during the early middle ages when the talent of independent judgment and original creative thinking was discouraged by the authoritarian system of education of the times. During this period, there was no guessing. If a question were asked that had not already been answered by the Church fathers, guided by the divine revelation of Aristotle, the doctorae ignorantae were tongue-tied and silent. Either the answer could be found in the proper text-books or the question itself was disbarred.

The Renaissance marked the rebirth of creative intellectual and spiritual vigor which had lain dormant through the middle ages. It began with a small group of men who were not afraid to guess in order to solve problems whose answers were not given beforehand; and although much of what they did has since been superseded, the method of inquiry which they invented still endures.

In a scientific laboratory, or in the practice of a profession based on the application of the results of science to human problems, facts are given, and rules are given, but the application of the rules to the facts, and the interpretation of the results, are never given beforehand. They are created by a synthetic activity of the mind—the act of judging; and no one pretends that such a creative judgment can ever be wholly free from the hazard of uncertainty. The solution of any non-factual problem is always personal and tentative; in the final analysis, the conclusion is a *guess* which represents a judgment drawn from an integration of the knowledge and experience of the individual thinker himself —a conclusion which can never be objective and final, but which can be intelligent despite its being a guess. As a matter of fact, education in

its deepest sense is primarily the training of the faculty of judgment, by means of which guesses can be formulated and evaluated with the maximum of intelligence.

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NOTES ON THE PROGRESS MADE IN THE DEVELOPMENT OF THE REFRACTING TELESCOPE FROM GALILEO TO DOLLOND*

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The news of Galileo's discoveries with the telescope spread quickly throughout Europe. With equal rapidity arose others like Simon Marius, David Fabricius and Christopher Scheiner, who, if they did not claim complete priority, demanded as independent discoverers a recognition similar to that given to Galileo. It is indeed clear that by 1612, four years after the invention of the refracting telescope by Hans Lippershey, other astronomers besides Galileo were observing the gyrations of the satellites of Jupiter and the passage of spots across the sun.

Galileo discovered the tiny moons of Jupiter in January, 1610, and published his observations in the same year.[1] Simon Marius, astronomer to the Elector of Brandenburg, asserted that he had seen the satellites in November, 1609, and even gave the name of a witness in support.[2] He strengthened his claims by constructing tables of their motion, and recent research has shown that he actually saw them before Galileo. David Fabricius apparently saw the solar spots from Wittenburg in June, 1611, about the same time as Galileo, and he published his observations in the same year.[3] Galileo's account[4] did not appear until 1612.[5] Christopher Scheiner, a Jesuit priest, was loud in his claims for the discovery of sunspots, but his claim rests solely upon his own assertion and is therefore inadmissible. He appears, however, to have seen the spots in November, 1611, and by 1639 was able to publish nearly 2,000 sunspot observations.[6] But he was at first mistaken about their true nature, and thought that they were opaque bodies in circulation round the sun, as opposed to Galileo and Fabricius, who stated that they were integral parts of the sun's surface, rotating with it and varying both in size and number.

These early observations of the sun are interesting because they reflect the limited optical knowledge of the learned in those days. It is remarkable that in so recent a period astronomers were at a loss how to observe the sun without injuring their eyes. Appian, in the 15th century, had recommended the use of coloured glass as a shield, but both Galileo and Fabricius seem to have been ignorant of his suggestion. Galileo

*†See footnotes at end of paper, page 82.

overcame the difficulty by observing the sun when it was low in the heavens or partially obscured by fine clouds. Fabricius, besides these expedients, projected the solar image from the telescope on to a white screen. Scheiner, however, adopted Appian's coloured screen placed between the object-glass and eyepiece, and was the first to recognize the importance of the Keplerian telescope with its convex eyepiece. He also has the merit of being the first to mount his telescope on a primitive equatorial stand in order to facilitate "following" the sun in its path across the sky.

The aberrations of these early telescopes, if not entirely disregarded, were considered an irremediable consequence of vision through lenses. No doubt the novelty of the instrument and its constructional difficulties claimed far more attention than any investigation of the then obscure origin of its optical defects. Galileo made his own telescopes and presented them to various persons in his own and other countries, although he kept his method of grinding and polishing to himself. Before his blindness, however, he imparted his process to Mariani, who in turn made telescopes after the Galilean principle.[7] In England also, as early as 1610, Thomas Harriot was in possession of one of the Dutch *trunk* telescopes: he was the first Englishman to see the solar spots telescopically. Sir Christopher Heydon and Sir William Lower were also in possession of telescopes at this date,[8] but in Italy, with its rich resources of glass and well-established glass industry at Venice and Florence, a concerted attempt was made to construct larger and better instruments. Both Torricelli, the disciple of Galileo, and Fontana of Naples assisted in this movement,[9] and Fontana discovered in 1637 an irregular spot on the planet Mars. Fontana contended that he had invented the astronomical or inverting telescope in 1608, three years before the publication of Kepler's *Dioptricks*. He also claimed to have invented the "double microscope."[9]

The theory of the astronomical telescope with two convex lenses was first explained by Kepler in his *Dioptricks*,[10] published in 1611. But he did not make one of this construction, and being engrossed on the theory of the planetary motions, relied on the observations of the others to either correct or confirm his computations.[11] The Keplerian form does not appear again until 1630 when Scheiner remarked[12] that he made some observations in 1617 in the presence of the Archduke Maximilian with a telescope composed of two convex lenses. Even after this date, in fact not until the invention of the micrometer by Gascoigne, did Kepler's telescope replace the Galilean in astronomy. So little known

was Kepler's claim that Rheita, writing in 1635, had all honour of the discovery. The inversion of objects by Kepler's telescope was a great disadvantage for terrestrial purposes, and the Galilean certainly gave brighter and more distant images. The convex eyepiece, however, gave a larger field of view and the early addition of a second lens produced an erect image although at the expense of a loss in definition. Rheita improved this construction by making erecting oculars consisting of three convex lenses, and at the same time laid claim to its discovery both in the single and binocular forms.[13]

The next impulse to the evolution of the telescope, although indirect, came with the publication of Descartes' book on dioptrics in 1637. Descartes realized that the ordinary spherical lens could not bring all the incident rays to one common focus and suggested instead lens surfaces of hyperboloid and elliptical figures.[14] From that date, and for many years after, all manner of ingenious machines and devices were invented in order to make aspherical lenses. Descartes himself commissioned Ferrier, a Paris optician, to grind aspherical lenses for the purpose of his experiments, but with no success.[15] Rheita was one of the first to make a machine for the same purpose, and he was followed by Hooke[16] and Wren[17] in England, and Hevelius,[18] Huygens,[19] Cherubin d'Orleans,[20] Borelly,[21] Duillier[22] and Maignab[23] on the Continent. But none of these workers met with any success, and it was not until about 1735 that a true paraboloidal curve was given to an optical surface.

Not to be outdone in their attempts to improve object-glasses, the opticians of this period evaded the difficulty by making them of long focal-ratio. This minimized the effects of both spherical and chromatic aberration, although before Newton's time the cause of the latter was entirely unknown. Telescopes became longer and longer, and with every slight increase in aperture the focal length would be increased to an absurd degree. Yet even these rather unconventional instruments added their quota to the progress of astronomy, and in the capable hands of Hevelius and Huygens achieved a considerable degree of success.

Johann Hevelius (1611-1687) was famous for the quality and variety of his astronomical instruments and for the accuracy of his observations. Introduced to the study of the heavens by Cruger, the author of several treatises on astronomy, he built in 1641 an observatory at his house in Danzig and furnished it with a sextant, four-foot quadrant, two telescopes, and other similar instruments. For four years he studied the moon's surface and in 1647 published the results of his observations

in a treatise called *Selenographia, sive descriptio Lunae et macularum euisdem*. It is in the first two chapters of this work that we find an account of his method of making telescopes. At first his instruments were of moderate length, and however imperfect compared with later standards, they enabled him to see the phases of Mercury's tiny disc. But Saturn and his rings kept the secret of their true nature from him, and he was no more successful than Galileo in explaining the enigmatical appearance of the disc and ansae. For this reason, therefore, his treatise, *De nativa Saturni facie*, published in 1656, has an interest more historical than scientific.

Three years later the publication of Huygens' *Systema Saturnium*[24] brought with it accounts of telescopes many times longer than those at Danzig. Hevelius at once attacked the problem, and in his *Machina Coelestis*, published in 1679, relates how he made a telescope of 150 feet focus. The grinding of the lenses seems to have given him less trouble than the design and construction of a suitable carrying mechanism. It soon became apparent that tubes of paper were neither durable nor rigid, and iron was too heavy and expensive. Hevelius therefore made his tubes of wood. His very long telescopes were sectional, each section consisting of two wooden planks fixed at right angles to each other. Three or four of these sections, joined end to end, made a tube over 100 feet long, or rather a two-sided trough which, although open, was at the same time fairly rigid and tight. At one end was the objective, at the other the eyepiece. This arrangement, braced by wooden stays, would have no doubt answered for use at night, but during twilight and moonlight it became necessary to exclude extraneous light. Hevelius therefore fixed circular wooden apertures or "stops" at intervals along the tube, and these not only assisted in its re-alignment but made each section more rigid.

Hevelius spared neither time nor money in the construction of his telescopes. The *Machina Coelestis*, with its beautiful plates and typography, is characteristic of the joy and labour that Hevelius both derived from and gave to his work. Not content with the erection of many large instruments at the Sternenburg, as his observatory in Danzig was called, he discussed plans for an ideal tower observatory suitable for the housing and erection of giant aerial telescopes. The fame of his own observatory spread throughout Europe, and if we judge his illustrations rightly, the erection of his giant 150-foot telescope was something of a big event in Danzig. He writes convincingly about the ease and rapidity with which he could prepare this telescope for observation, but the oppo-

site was more probably the truth. In the first place a band of assistants was necessary to work the different ropes and pulleys that raised and directed the tube, and then the object had to be "followed" owing to the diurnal rotation of the heavens. This is difficult enough in a small telescope of a few feet focus, let alone with a long flimsy tube moved by several pairs of rough hands. Only the finest nights were suitable for observations, for the slightest breeze would cause the framework to quiver like a reed. The warping of the wooden laths presented another difficulty, and the "give" in the ropes due to changes in humidity must have necessitated an almost constant readjustment of the tube and guiding mechanism.

Hevelius was one of the first members of the Royal Society of London and maintained a large correspondence with his friends in England and France. With the publication of his *Cometographia* in 1668, he sent copies to several members of the Royal Society, among them Hooke. In return Hooke sent him a description of a refracting telescope and recommended its use on graduated instruments instead of the plain sight. This led to the well-known controversy between them. Hooke asserted that distances could be taken to the exactness of one second of arc only by the help of a telescope, and that the measures of Hevelius taken with a plain sight were therefore quite inaccurate.[25] Hevelius was never quite sure of his position with Hooke; like Newton he was subjected to a tone as patronizing as it was sometimes accusing. Like Newton he was always willing to exchange ideas with Hooke, but when the latter took the liberty of questioning the truth of his observations he was naturally offended. In 1679 Halley was sent by the Royal Society to see Hevelius and to show him the nature and use of the telescopic sight.[26] Hevelius received him warmly and the two astronomers made and compared observations. But he never became convinced of the superiority of the telescopic sight. Shortly after Halley's departure from Danzig a fire broke out in Hevelius' house, and his entire library and observatory were destroyed.[27] He bravely raised up a new edifice upon the old, although then in his 68th year, and received new books and lenses from Halley.[28] Observations were continued with the same passionate enthusiasm, although he could never hope, in the few years that remained to him, to see the new observatory rival the grandeur of the old Sternenburg.

Contemporary with Hevelius was Christian Huygens (1625-1695) who, as a young man, took a great delight in making lenses for refracting telescopes. Assisted by his brother Constantine he made, in 1650,

a comparatively large glass of 2 1/3 inches aperture and 12 feet focus. The new glass was soon turned towards the planet Saturn in the hope that the curious appendage seen by Galileo would reveal its true nature. Nothing very decided was seen, however, but on March 25th, 1655, Huygens discovered Titan, the largest of Saturn's family of satellites.[29] This addition to the solar system raised the known number of satellites to six and equal to the number of planets. The aggregate of twelve bodies made what was known as a "perfect" number and Huygens, misled it is said, by current ideas about the harmony of numbers and perfect design in the solar system, did not trouble to look for more.[30] The 12-foot telescope revealed dark spaces in Saturn's mysterious appendage, however, although they were seen more distinctly with a 23-foot telescope made afterwards. In 1656 the ring appeared edge-on and remained invisible even with a telescope of 123 feet focal length.[31] But in 1659 Huygens was able to publish[32] for the first time that the appendage was "a ring, thin, plane, nowhere attached, and inclined to be ecliptic."

Huygens was the first to discard the long tubes that encumbered the refracting telescopes of his time. Instead he mounted the object-glass in a cell and placed it at the top of a high pole. A ball and socket device enabled the observer down below to move the delicately balanced cell by means of a connecting thread. The image was received by an eyepiece usually carried in an adjustable frame made tripod fashion, and the thread from the objective was connected directly with the eyepiece mount.[33] The device was obviously difficult to manipulate, although as usual the difficulties were glossed over by the inventor. For instance, it was no easy matter to find the focus of the objective. A bright image could sometimes be found by receiving it first upon a white pasteboard ring fixed round the eyepiece, but on a dark night a lantern was used to illuminate the objective whilst the observer searched for the reflection.[34] The thread helped to keep the object-glass and eyepiece in alignment, but with little degree of accuracy, and no provision was made for preventing the dilution of the image by extraneous light.

The greatest advance made by Huygens in the construction of telescopes was undoubtedly his improved method of grinding and polishing lenses of long focal length. Fortunately for us he traveled to England in 1661 and communicated to his friends at the Royal Society his process of lens-making. But his success in this direction lay not so much in his method as in the skill of hand which many years' practical work had given him. Samuel Molyneux, several years later, gave an account of

Huygens' technique in Dr. Robert Smith's classic *Opticks*.[35] It is interesting to note that his father, William Molyneux, author of the *Dioptrica Nova*,[36] visited Huygens in 1685 and was shown the various instruments in his garden at the Hague. Probably this early contact with the famous Dutchman did much to kindle the great interest evinced by the elder Molyneux in the improvement of the astronomical telescope.

Huygens' method of making a long-focus objective was as follows: A bi-convex form was taken to simplify working and a gauge cut to the required radius. Tools were of either copper or brass and in size generally exceeded twice the proposed diameter of the lens. The brass was cast in a round flat slab about ½ inch thick and then ground with emery and circular flat grinding-stones of increasing size until the required gauge was reached. Two grinding-stones usually sufficed, one about half the size of the tool and the other nearly equal to it. The tool was then polished with dry pitch and fine emery. To assist the abrasion great pressure was applied to the polishing-stone. Newton[37] thought that too much pressure tended to deform the shape of the tool and polisher, but Huygens went to the other extreme by placing a long bent pole between the polisher and the ceiling of the room. This acted like a strong spring, and so great was the pressure that usually two persons were required to give the polisher the necessary motions.

A block of slate stone, a little smaller than the glass and ground round and to the concavity of the brass tool was then perforated in the middle and coated with a mixture of pitch and wax. This slab, now the polisher, was covered with kersey cloth, also perforated at the centre, and applied to the glass objective. The perforation enabled a hollow conical plate of steel to penetrate into the slate, and this cone received the lower end of a long pole, pivoted in the ceiling of the workroom. A final polish with tripoli or putty completed the operation, for no attempt was made to parabolize the lens surfaces.

The completed objective had to be tested either in the workroom or upon some well-known celestial object. Light reflected from the lens surfaces gave some idea of the quality of the polish and the examination of the refracted cone of light in the region of the focus decided the accuracy of the curves. Failing this test it was customary to view some object placed a considerable distance away from the observer. A page of the *Philosophical Transactions* with its familiar type was often used for this purpose,[38] and the ease with which it could be read with different magnifying powers was a rough criterion of the resolving power of the

telescope. Another method, one which gave an idea of the performance of the telescope under typical observing conditions, was to examine star and planetary discs or fine lunar details. But with objectives of very long focus varying atmospheric conditions rendered the results unreliable, particularly in the climate of Danzig and the Hague. Hevelius often obtained large spurious discs for the stars with his 150-foot telescope, and by diminishing the aperture he gave them measureable discs.[39] These, he thought, represented the actual discs of the stars and so he made laborious but useless measures of their diameters with his bar micrometer. J. Cassini was similarly deceived by these appearances as late as 1717,[40] but Huygens claimed that the diameters were insensible and were no doubt due to an anomaly of vision. Flamsteed, however, observed at Derby with a 14-foot refractor, found some discs to be of very appreciable size; he thought that Huygens' inability to see them was due to his method of slightly smoking the lens of the eyepiece.[41]

According to Huygens, he and his brother made aerial telescopes of 170 and 210 feet focal length. In 1691 Huygens presented an object-glass of 123 feet focus to the Royal Society, and this same glass was entrusted to Hooke and Halley who had orders to "view the scaffolding of St. Paul's Church, to see if that might not conveniently serve for the present to erect the object-glass thereon, for viewing such of the celestial bodies as now present themselves."[42] In 1710 James Pound, the astronomer, borrowed the glass from the Royal Society and mounted it at Wanstead Park on a maypole just removed from the Strand. The fact that Sir Isaac Newton was instrumental in procuring this pole gave rise to the verse attached to it by a local wit:[43]

"Once I adorned the Strand,
But now have found
My way to pound
In Baron Newton's land."

Crosthwaite, the assistant of Flamsteed at the Royal Observatory Greenwich complained bitterly of the defects of this aerial telescope, but Pound nevertheless turned it to good account. He observed and made micrometrical measurements of the positions of the satellites of Jupiter and Saturn, measured the diameters of the planets' discs and the ring of Saturn, and furnished both Halley and Newton with valuable data.[44] At a later date the object-glass came into the hands of Cavendish, who compared it with one of Peter Dollond's triple-objective refractors and found its manipulation extremely tiresome and laborious.[45] Still later

(about 1835) W. H. Smyth, the astronomer, thought of re-erecting it in order to assess its capabilities, but the project offered so many difficulties that it was laid aside.[46] Sir Isaac Newton possessed another Huygens' glass of 170 feet focus, and in 1724 the Royal Society was presented with the famous 210-foot objective (now in the Science Museum), complete with its short iron mount and some eyepieces.

Huygens' invention of the compound negative eyepiece with its wide field and achromatic properties now known by the name of its inventor, was a noteworthy improvement on the single lens ocular. Huygens was also one of the first to appreciate the use of "stops" in lens systems, and to employ one in his eye-glasses, fixed between the two lenses and in the plane of the image.[47] Of more indirect though of no less importance was his formulation of the wave-theory of light in 1678, and his satisfactory explanation of reflection, refraction, and the phenomenon of double refraction in uniaxal crystals. But such was the prestige of Newton after the publication of the *Principia* and *Opticks*, that the undulatory theory supported by Huygens and Hooke did not become universally accepted until nearly 150 years later.

Besides Huygens, the first persons to distinguish themselves in the grinding of telescope lenses were two Italians, Eustachio Divini at Rome, and Campani at Bologna. These two craftsmen were rivals, and their rivalry stimulated the progress of the refracting telescope. Campani appears to have been the better workman, although the success of his telescopes was, to a very large degree, due to the remarkable discoveries made with their aid by the famous French astronomer, Jean Dominique Cassini. Campani's objectives were paper polished and chosen from the finest Venetian glass; besides which he was reputed to possess remarkable dexterity in the working of glass surfaces.[48]

In 1650 J. D. Cassini became professor of astronomy at the University of Bologna. Here he became acquainted with the work of Campani and under the lucid Italian sky made many important planetary observations. In the years 1665 and 1666 Cassini and Campani together observed spots on the disc of Venus and deduced a period of rotation for that planet of 23 hours.[49] In 1669 Cassini went to Paris at the request of Louis XIV, and when given the task of organizing the Paris observatory, did not delay in asking Campani for instruments. The Italian thereupon made telescopes 86, 100 and 136 Paris feet focal-length, and these, together with smaller glasses, formed the nucleus of one of Europe's finest observatories. In October, 1671, Cassini discovered

Japetus, another satellite of Saturn, and by 1684 he had discovered three more. All four were discovered at Paris and with Campani's telescopes. With the same glasses and others of 200 and 300 feet focal-length, Cassini recorded the motions of these tiny bodies, observed the sun, moon and planets, and particularly any comets that were visible. In 1675 he made the interesting discovery that Saturn's ring was double, being separated by a space now known as "Cassini's Division."[50]

After his death Campani's laboratory was purchased by Pope Benedict XIV and presented to the Academy at Bologna. His instruments were used at Rome for many years, and in 1726 Bianchini, the domestic prelate of the Pope, announced that his observations of Venus with 25 and 35-foot telescopes by Campani had revealed that the planet rotated on her axis in just over 24 days.[51] When we consider the delicate nature of these observations by Cassini and Bianchini and remember that they were made with non-achromatic telescopes, we are bound to recognize the distinctive merit of Campani's glasses.

In France, we are told,[52] Auzout and Hartsoeker made telescopes of 300 and 600 feet focus. But it does not appear that they actually used such instruments for astronomical observations. These glasses led men to fabricate many strange notions regarding their magnifying power; the animals on the moon, they claimed, besides many other wonders,[53] would no doubt be visible with a magnification of 1,000. Hooke in England suggested a device for both lengthening and shortening telescopes. To increase focal length he suggested[54] placing a water lens behind the glass lens, and to shorten a telescope he devised[55] a system of mirrors which, by successive reflection of the light from the objective, kept the dimensions of the instrument to those of a small box.

Auzout was one of the first to improve the eyepiece-micrometer and to apply the telescope to graduated instruments. His account of the first moving wire micrometer was sent to the Royal Society in 1666,[56] but it was found later that Gascoigne, an Englishman, had used this form of micrometer as early as 1649.[57] It also appeared that Gascoigne saw the advantages of telescopic sights in making quadrant and sextant observations many years before Huygens, Auzout or Picard, although at the time of Auzout's claim the French naturally gave their countryman priority.

In England the Royal Society, represented by such men as Hooke, Wren, Halley, and later Bradley, encouraged researches in the improvement of the refracting telescope and micrometer. Sprat, in his *History of*

the Royal Society, gives an account of their early optical labours and says that they constructed "several excellent telescopes of divers lengths of six, twelve, twenty-eight, thirty-six and sixty feet long, with a convenient apparatus for the managing of them; and several contrivances in them for measuring the diameters and parts of the planets, and for finding the true position and distances of the sun, fixed stars, and satellites."[58] Hooke made several observations with a long aerial telescope erected in the quadrangle at Gresham College,[59] and Rowley proposed placing an objective at the top of one of the towers of St. Paul's to detect stellar parallax.[60] It is well known that about this time the newly-erected Monument was used for the same purpose, but the attempt was abandoned owing to vibrations and movements in the mass of the column.[61]

It gradually became clear that long-focus telescopes were by no means ideal for observations such as these, and a greater measure of success was obtained with instruments of 20, 30 and 35 feet focal length. For terrestrial purposes long telescopes were both heavy and clumsy, and there was a greater demand for the Dutch "perspective," "cylinder" or "trunk," as the Galilean telescope was then called. Both these and the longer terrestrial-eyepiece telescopes were made in the modern sliding tube form, with tubes of either cardboard or wood. Body and draw-tubes were usually covered in fish skin or green vellum, after the Italian style, and were often arranged to accommodate two objectives, one for day and one for night observations. The London opticians, Reeves, Christopher Cock, Marshall, Howe and Yarwell, made telescopes of this pattern which were certainly equal to the best Continental instruments.

When we consider that aerial telescopes were already in use before Newton's work on optics, it becomes surprising that others did not anticipate him in the explanation of chromatic aberration. With telescopes of even 10 and 20 feet focus, and these were by no means uncommon, the separation of the red and violet images should have suggested a difference in the refractivity of the objective for these two colours. Newton, when a student at Cambridge, read the optical works of Kepler and Descartes and became so interested in the theory of the telescope and Descartes' aspherical surfaces that he made several lenses for the purposes of his experiments.[62] He soon discovered the serious effects of chromatic aberration upon the telescopic image, and in 1666 he was led to examine the formation of a coloured spectrum by passing sunlight through a prism.[63] This famous and often quoted experiment

led, as is well known, to the explanation of colour and the idea that refraction and dispersion were inseparable.

Newton applied his theory to the long-focus telescope objective and after many careful investigations was able to demonstrate the futility of improving the single lens as far as chromatic aberration was concerned. "The Imperfection of Telescopes," he wrote,[64] "is vulgarly attributed to the spherical Figures of the Glasses, and therefore Mathematicians have propounded to figure them by conical Sections." But he went further than this and took it for granted that all media possessed the same dispersive power. "Now were it not for this different Refrangibility of Rays, Telescopes might be brought to a greater perfection than we have yet described, by composing the Object-Glass of two Glasses with Water between them."[65] No further improvement of the refracting telescope was possible upon this assumption, and we find Newton turning his attention to a reflecting telescope. "And the Refractions on the concave sides of the Glasses will very much correct the Errors of the Refractions on the convex sides, so far as they arise from the sphericalness of the Figure. And by this means might Telescopes be brought to sufficient perfection, were it not for the different Refrangibility of several sorts of Rays. But by reason of this different Refrangibility, I do not yet see any other means of improving Telescopes by Refractions alone than that of increasing their lengths, for which end the late contrivance of Hugenius seems well accommodated . . . Seeing therefore the Improvement of Telescopes of given lengths by Refractions is desperate, I contrived heretofore a Perspective by Reflexion, using instead of an object-glass a concave Metal."[66] Newton made two tiny reflecting telescopes, and sent one to the Royal Society. It naturally excited great interest both in this country and abroad, but it was not until 1723 that opticians saw in Hadley's 5-foot Newtonian a formidable rival to the refracting telescope. A comparison made in that year between Hadley's instrument and the 123-foot aerial telescope of Huygens showed that the reflector was quite equal, if not superior, to the refractor.[67]

The delay in the improvement of Newton's reflector meant that aerial telescopes of moderate length still held their own until well into the 18th century. They were employed by Flamsteed at Greenwich Observatory (founded in 1675). Abraham Sharp, who made many instruments for Flamsteed, both ground and polished several long-focus objectives. As late as 1722, Bradley used an aerial telescope of 212¼ feet focal length with which he measured on December 27th the diameter of

Venus.[68] Sharp himself used a 16-foot telescope which he rested on the branches of apple trees in his orchard at Horton.[69] He favoured small instruments, for despite the labour and care spent on larger glasses the images they gave were too poorly defined for accurate micrometrical work.

As in many other cases, the weight of Newton's authority delayed the progress of the telescope for many years, and it never occurred to the majority of his countrymen to test the validity of the fundamental conceptions in the *Opticks*. The possibility of alternatives led David Gregory in 1695 to suggest[70] that a combination of refractive media might correct chromatic aberration as apparently in the human eye. The convictions of Chester Moor Hall, thirty-four years later were greater and, as I have shown elsewhere,[71] Hall was the first to design an achromatic lens. Even John Dollond refuted Euler's attempt to produce a similar lens with the words, "It is . . . somewhat strange that anybody nowadays should attempt to do that which so long ago has been demonstrated impossible."[72] But the news of Hall's success made him reconsider the subject and in consequence the first achromatic telescopes were made and sold to the public.

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*An abridgment of the original material "Aerial Telescopes," presented with original illustrations in the Dioptric Review, Vol. 41, No. 2, pp. 117-133.

†Many visual problems were first brought to notice as a result of astronomical observations, and much research that has since proved of value to ophthalmic optics was initiated by opticians working in the interests of astronomy. The resolving power of the eye, magnification, aberrations of the eye and of optical instruments, absorption of light by the medium through which it is passing, protection of the eyes from glare, lens grinding techniques—these are just a few of the problems common to the two branches of optics which are touched upon in the report presented by King.

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NATIONAL REGISTRATION AND RECIPROCITY*

The subject of reciprocity has been before optometrists and members of other state licensed professions since state examining boards came into being to assure the public that certain standards of health work would be maintained. In optometry, as in other health specialties, the

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standards varied at first from state to state, and even today there exists some variance of educational acceptance and training backgrounds among boards in different sections of the country.

This variance is naturally a bar to free and easy reciprocity among boards, and as a result, optometrists frequently ask why there is not some form of national optometric registration which would make it possible for a qualified optometrist to practice optometry as a registered optometrist in any state in the United States without securing a license in each state in which he wishes to practice.

The answer is found in the principle referred to as "states rights." According to Article X of the Bill of Rights, "The powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the states respectively, or to the people." The power of licensure in the various professions is not delegated to the United States by the Constitution, therefore, it is reserved to the states.

At this stage of the discussion it might be well to point out that ophthalmologists have a national registration of a non-statutory type. Theirs is a form of voluntary registration which has no standing at law. It is somewhat similar to that now in practice in optometry in the Fellowship requirements for the American Academy of Optometry. From an optometric standpoint, however, if we cannot have statutory national registration of optometrists, what can be done to facilitate the licensing of optometrists who move from state to state?

A national examination is a possibility. In order to have a national examination it would be necessary to have a national board of examiners to prepare, conduct, and grade examinations as well as to pass on the qualifications of applicants who wish to take the examination. There are, however, a number of facts that should be taken into consideration in connection with the possibility of this type of national examination. These facts are as follows:

(1). It would be necessary for each state to amend its optometric practice act to give the board of optometric examiners authority to accept the national examination in lieu of its own.

(2). The requirements for admission to a national examination and the examination itself would have to be of such high character that each state could and would consider accepting the national examination in place of its own state examination.

(3). A national board of optometric examiners would have no authority to issue a license to an optometrist to practice optometry.

(4). A record of having passed a national examination would not necessarily mean that a state would grant an optometrist a license to practice optometry, because the specific requirements stipulated in the optometry law of that state would have to be met.

(5). Even though an optometrist passed a national examination he would have to obtain a license to practice optometry as a registered optometrist in each state in which he wished to practice as such.

(6). An optometrist would have to pay a fee for a national examination. This probably would be high because of the expense involved in the maintenance and functioning of a national board of optometric examiners.

(7). In addition, it would be necessary for the optometrist to pay the license fee in each state in which he secured a license to practice. At the present time these fees average around $25.

It is evident from this review that a national examination for optometrists would not enable an optometrist to move freely from state to state without regard for state licensing, but it would facilitate registration in those states which would accept the national examination in place of their own examination.

To date, no definite action has been taken to develop a national board of optometric examiners. However, some of the activities of the International Association of State Board of Examiners in Optometry, the American Optometric Association and the American Academy of Optometry constitute steps in this direction. To mention but a few of these activities we might point to:

(1). The International Association of State Boards of Examiners in Optometry is now working with most state boards of optometry to effect greater uniformity in the work of these boards. This International Board has developed standard examination procedures and test questions which are available to member boards. More and more boards are using these standard aids.

(2). The committee on education of the American Optometric Association has already done much fine work which will be of great future value in the development of a program of national examination of optometrists in its activities as these have to do with the improving and standardization of optometric education in our schools of optometry.

(3). The work of the American Academy is another step. This organization has already developed a standard qualifying test of high

order and its membership constitutes a qualified pool of selected optometrists already set up on a national level.

The question of national registration and reciprocity as a means by which an optometrist may obtain a license without a separate state examination for each state has baffled the individual optometrist for many years and has presented our organizations with almost insurmountable difficulties. Yet progress has been made.

Today, all of the forty-eight states, the District of Columbia, the Territories of Alaska, Hawaii and Puerto Rico have enacted laws relating to the practice of optometry. To be sure no two of these laws are identical but there has been a tendency towards both uniformity of thinking and action on the part of boards which should assist in solving the question.

Most of these laws provide for licensing without examination of optometrists registered in other states, but the provisions vary considerably. For example, in certain states the "reciprocity" provisions are based upon the qualifications of the applicant. In other states the provision is based on the school of optometry from which the applicant is a graduate. In still others the provision is based upon the optometry law under which the applicant is now registered. We also find in these separate state laws that qualifications of the applicant for license to practice optometry vary both as to preliminary training and professional preparation. It is evident therefore that much work still remains to be done in order to establish the uniformity necessary for orderly and desirable reciprocal agreements between states.

To present a statutory solution to this problem, three steps will have to be taken. Each will require time and work, and some expenditure of funds. These steps are as follows:

(1). Uniformity of standards of optometric education.

(2). Uniform state optometry laws or at least uniform amendments to existing laws having to do with examination, registration and reciprocity, and

(3). The establishment of a national board of optometric examiners to work with, and for those states willing to cooperate in this program.

(1). UNIFORM STANDARDS OF OPTOMETRIC EDUCATION.

Much excellent progress has already been made in this phase of optometric endeavor. Under the leadership of Woll, Sheard, Fitch, Fry,

Hutchinson, Needles and others, we have already achieved a great deal that is fine. Greater emphasis in the immediate future can and will complete this job. The schools, the boards and our optometric organizations are willing and must continue to work in close harmony on this important problem. All Class "A" optometric schools are now presenting to their students approved college curriculums which meet minimum college standards and which, in the post war period, may rapidly be expanded to meet every important educational professional requirement. Irrespective of its implications on other important optometric problems, this is imperative to safeguard the very future of optometry itself.

(2). UNIFORM STATE OPTOMETRY LAWS OR AMENDMENTS HAVING TO DO WITH REGISTRATION AND RECIPROCITY.

At first, the thought of arranging for a general degree of uniformity in the various state optometry acts seems staggering. Yet the problem certainly is not too difficult and within a period of five years much valuable work in this direction could be accomplished. The procedure would be fairly simple.

First, a permanent Joint Optometry Commission on Examination, Registration and Reciprocity, on a national scale, should be established. This commission should represent the schools and colleges, the state boards, the American Optometric Association and the American Academy of Optometry. This commission should be financed on a permanent basis jointly by the Academy and the American Optometric Association.

Second, the commission, with proper legal assistance, would draught (a) a complete model optometry law; and for those states who would not wish to pass an entirely new law, (b) a model amendment to an optometry law, this amendment having to do with optometric board examination, registration and reciprocity. In the model law or proposed amendment, the subjects of proper qualifications and education of applicants would be covered, as well as giving the candidate the choice of taking, (1) a state examination, or (2) a national examination.

The legislation would include, that where the candidate elected to take the national examination, the state board of optometry examiners would be authorized to accept the findings and grades of the national board of optometry examiners in lieu of its own grades and examination findings, thus establishing a national basis for optometric reciprocity.

Third, the commission would then present its work to the optom-

etrists of the various states, urging them to initiate the proper action in the next session of their state legislature.

It is the writer's forecast that if the suggested plan is followed that in a number of states, optometrists will immediately take appropriate steps to have this progressive new material incorporated in the optometry laws of their respective states. Following these leaders, other states will join, until a high percentage of optometry laws will include these new provisions.

(3). THE ESTABLISHMENT OF A NATIONAL BOARD OF OPTOMETRY EXAMINERS.

While working on the uniformity of laws, the Joint Optometry Commission on Examination, Registration and Reciprocity would also prepare plans for and actually bring into being a National Examining Board of Optometry. The members of this board would be selected by the commission itself, and operate under the general supervision of the commission.

The new board should, at the earliest opportunity, examine candidates, even though as yet being unrecognized by any existing optometric legislative act. It is important that the board be functioning and in operation when the first new or amended bills are submitted to a state legislature for approval.

It must be remembered that reciprocity between states in optometric legislation is quite like commercial reciprocity between nations. Its major idea is a sort of state treaty, by virtue of which certain advantages and privileges offered by one state are responded to by equal advantages and privileges from another state. This rather naturally presupposes at once a rather general equality of conditions, plus a specific conformity to definite and known standards, so that the value of the privilege offered is as great as the value of the privilege granted.

The plan proposed provides this equality or uniformity of conditions both in the optometric acts themselves and in the selection of proper candidates, as it takes into consideration pre-college training, professional education, and a final examination of the optometrist. All these are necessary steps in bringing about the greatest freedom of reciprocal relations between the various state boards of optometry and the optometrists they supervise.

CAREL C. KOCH

TRANSACTIONS OF THE AMERICAN ACADEMY OF OPTOMETRY

A department devoted to announcements, reports, appointments, organization data, news, professional problems and ideals, as these relate to the Academy.

REPORT OF ACADEMY ADVISORY BOARD*

Don R. Paine, O.D., F.A.A.O., Chairman

Since the Advisory Board has been but recently instituted it is well to preface this report with a declaration of its function.

The function of the Advisory Board is to serve as a planning and policy screening board, each member of which is supposed to be assigned one or more policies of service recommended in the President's address for the purpose of assisting the President and his Executive Council in materializing such proposals.

On the outset it must be made clear that the part played by the Advisory Board has been very small indeed compared with the untiring and determined endeavor of President Wheelock, who is to be given full credit for putting into operation constructive plans intended to broaden Academy service.

It has been the pleasure of this Board to thus deliberate with the President and the Council toward the end of instituting some of the activities in a long range expansion program consisting of such activities as (1) establishing of a sectional congress on the West Coast; (2) establishing of local Academy Chapters; (3) establishment of a Committee on Professional Practice and Standards. Since the latter has not been previously reported it is well to submit the following account.

Committee on Professional Practice and Standards. Chairman Dr. Don R. Paine and Committeemen Dr. Irvin Borish, Dr. Richard Hall, Dr. Glenn Fry, and Dr. Carel Koch.

The purpose of this Committee is to exert the Academy's influence directed toward encouraging higher ethical and professional standards of practice by a greater number in the ranks of Optometry. This is to be accomplished by a series of articles on the subject from the pens of members of the Committee and others within our ranks published and otherwise broadly disseminated.

*Report presented to the AMERICAN ACADEMY OF OPTOMETRY at Chicago, Illinois, December 10, 1944.

The first of such articles was written by Chairman Paine under caption, "Professionalism as Related to Optometry." This article was published first in the Archives and then sent out by President Wheelock for publication to all National and State Optometric Publications. Other articles on the subject by other authors, it is trusted, will appear in due time.

(4) Academy sponsorship of the Junior Academies in Optometric Colleges.

While it was my pleasure to work with the planner, sole credit for this important plan, now in its embryo stage, belongs to and will at the proper time be reviewed by the originator and drafter of the plan, Dr. Irvin M. Borish.

The foregoing abridged report by Dr. Don R. Paine was accepted by the Academy, with the authorization to the Executive Council that the work already started by the Advisory Board be continued. The personnel of the 1945 Advisory Board will be announced in the Transactions of the American Academy of Optometry section of the March issue of this Journal.

It is with great regret that, for health reasons, the Academy was forced to accept Dr. Don R. Paine's resignation as Chairman of the Advisory Board. For three years Doctor Paine has held this post, during which time his contributions to the Academy and the profession have been of great value.

ACADEMY FOUNDS NATIONAL OPTOMETRIC UNDERGRADUATE HONORARY SCHOLASTIC FRATERNITY, ALPHA ALPHA OMICRON

Irvin M. Borish, Ph.D., F.A.A.O.

I. INTRODUCTION.

Because of the need for emphasis upon proper inculcation of ethical ideals in the students now entering the profession, and because it seems to be generally conceded that such indoctrination of the newer practitioners constitutes the major hope for the survival of the profession, the American Academy has approved the following plan as a part of its desire to contribute to the general program of professional advancement. The Academy considers itself particularly suited to this undertaking because it comprises the *only homogenous group of practitioners* insofar as standards of practice are concerned, in the profession; and because its standards are identical with and typical of those of any other accredited profession.

It believes that it can contribute by the best method of teaching—that of direct example. For only its membership collectively demonstrates that economic success and stability are entirely compatible with the highest ethical standards.

In addition, since its membership contains not only those who represent the foremost ethical type of practice, but also the majority of the leading scientific and technical luminaries in the field, it believes that it may serve as an inspiration along both the paths by which a profession must advance—increasingly higher standards of practice, and increasingly greater technical skill.

To accomplish this aim, any indoctrination which the Academy can perform must be instituted as early in the neophyte's career as possible—specifically, while he is still an undergraduate. However, since the student's understanding of the conditions involved is dependent upon his knowledge of the field, the Academy does not believe that its contribution can be overly effective before the student has reached the Senior year of schooling.

In consideration of these aims and desires, the Academy believes that the most feasible means of accomplishing this is by assisting in the formation of a series of chapters of an undergraduate honorary scholastic fraternity. Such chapters will be assisted by the Academy by all contributions which the Academy will be able to make towards its membership, but will *not be* controlled by, directed or otherwise influenced, and these chapters will be essentially undergraduate organizations subject to the normal controls of such organizations in the institutions in which they were located.

It has been approved that such a group of honorary fraternity chapters be called "Alpha Alpha Omicron," the Hellenized version of the initials of the American Academy of Optometry—a name which has been checked in the National Registry of Greek Letter Fraternities and is not, at present, in use.

II. ADVANTAGES TO THE STUDENT.

A. The organization will serve as a national honorary scholastic society for Optometry, an organization now needed in the field and conferring distinction upon the student.

B. Membership will serve to certify graduates as *academically* acceptable for fellowship in the Academy, and will for this group serve in lieu of the present examination.

C. Membership will confer the privilege of attending the meetings of the Academy, meeting the leaders in the field, receiving the Academy Archives, and similar inspirational and educational motivation.

III. METHOD OF ORGANIZATION.

A. For the present, each College will found its own chapter in direct affiliation with the American Academy. The question of eventual consolidation of the various chapters into one organization would be implied, but would have to wait for more propitious times.

B. The present fellows of the Academy who are on the faculties or administration of the various colleges will found the chapters and will exert direct supervisory control of the specific undergraduate chapters. Where desired, such members may invite members of a local chapter of the Academy or members of the Academy in nearby residence to share this function.

C. Each individual chapter will be known by the name of the institution in which it resides, as the Ohio State Chapter, Los Angeles Chapter, etc.

D. It is recommended that each institution in which a chapter exists, describe the nature and affiliation of the chapter in its official bulletin or catalogue.

IV. MEMBERSHIP.

A. Two classes of members will be established.

1. Active members will be automatically elected upon the basis of scholarship alone from the various student bodies.

a. A "B" average or the equivalent in grade points will be required.

b. Only students who have completed the Junior Year with such an average may be elected to membership.

2. Graduate members may be elected by the Active membership.

a. Only members of the American Academy may be elected.

b. Only alumni of the college in which the chapter exists may be elected, except that faculty men or alumni of colleges no longer in existence may be elected.

c. The initial graduate members will consist of those members of the Academy who occupy faculty or administrative posts

in the college in which the chapter exists and who will exert sponsorship and supervision of the chapter.

V. CONSTITUTION OF LOCAL CHAPTERS.

A. The Constitution will be modeled upon that of the American Academy.

B. It will provide for the two types of members and for a President, Secretary, Treasurer and Historian.

C. A copy of the Constitution must be submitted to the Academy for approval.

D. All finances will be in the hands of the local chapter except that the chapter would pay the Academy for services rendered; keys, certificates and journal subscriptions.

VI. STATUS OF MEMBERS.

A. Active members will be granted the following privileges by the Academy:

1. Attendance at annual Academy meetings.
2. Receipt of the Academy Journal.
3. A certificate of membership issued by the Academy in the name of the society.
4. A key issued by the Academy in a base metal or in gold. It will be advisable to have both on hand, since the student would pay for the one he desires.
5. Attendance at meetings by Academy members visiting the community in which the Chapter meets, either by previous arrangement or coincidence, and other such measures fostering the association between Academy and Society.

B. Active members will upon graduation become graduate members of the Society and probationers of the Academy itself.

1. This status will exist for not less than two years.
2. Upon the conclusion of the probationary period, such members will be eligible for admission as fellows of the Academy upon proof that all the requirements of the Academy have been met, except that the examination for admission will be omitted.

a. Case record reports would then be submitted.

b. Proof of mode of practice would then be offered.

3. Probationers will be interrogated by the Secretary of the Acad-

emy as to whether they wished to remain probationers or to be dropped from the rolls, if they had not applied for admission at the close of probationary period.

a. A probationer engaged in an unsatisfactory type of practice would be automatically dropped from the rolls, and so notified by the Secretary.

b. A probationer who desired to remain in such a status would be required to so notify the Secretary of the Academy.

c. A maximum time limit of seven years (five above the two minimum) has been set on the probationary period. A candidate not applying for membership within that time will be dropped from the list.

VII. TENTATIVE ACADEMY STATUS OF UNDERGRADUATES WHO ARE NOT MEMBERS OF ALPHA ALPHA OMICRON.

A. All students who fail to be selected for Alpha Alpha Omicron may still apply for fellowship in the Academy by either the regular channels or by the following means of attaining probationary status.

1. Students not members of the honorary fraternity but who will graduate within one school year will be permitted to attempt the regular examinations for admission to the Academy. Such examinations may be attempted at the regular annual session of the Academy or at such times as the Executive Council of the Academy may determine.
2. If such an examination is satisfactorily completed, the candidate will be entered upon the probationary list in the same status as the graduated fraternity member.
3. Such a probationer is not to be considered a graduate member of the fraternity, however, and will not receive a certificate or key.
4. The advantage of choosing this method rather than the standard method of applying for admission to the Academy lies solely in the fact that the student is given the opportunity of attempting the examination at a time when much of his academic training is fresh in his mind rather than some years later.

VIII. PERPETUATION.

A. Since One Senior Class may graduate before the following Juniors become eligible for membership, it is necessary that the fellows of

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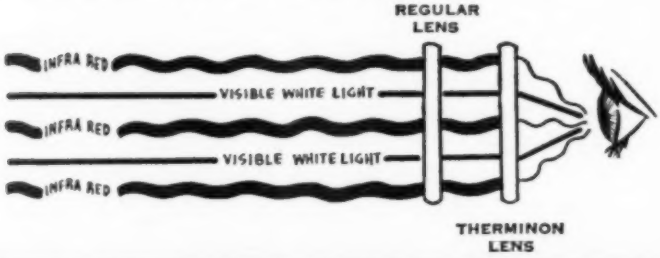

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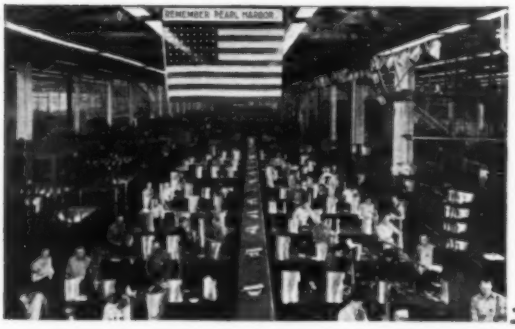

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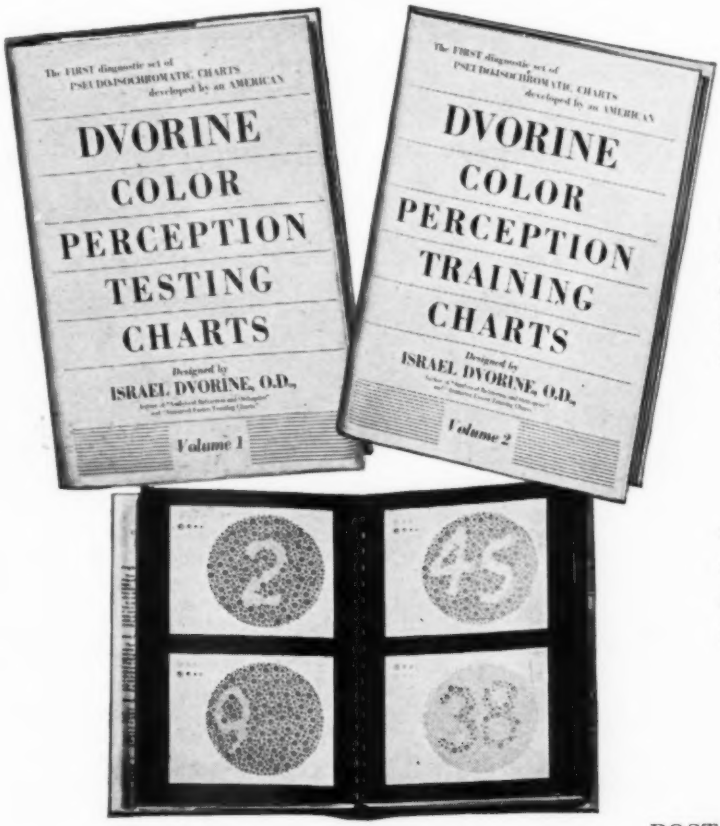

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the Academy who supervise the chapters serve as the bridges between classes, and introduce the new members to the significance of the Society, transmit the records, etc. As selection is based on scholarship, no selection committee is needed. The probationary period protects the Academy from those who may be academically acceptable but may prove otherwise undesirable.

IX. FUNCTION OF THE ACADEMY.

A. The Secretary of the Academy will conduct the following duties:

1. Establish files listing the various chapters and memberships, a probationer's file, a bring-up file for probationers, etc.
2. Arrange for the manufacture of keys and the printing and engraving of certificates and to supply them as required.
3. Publish the roster of chapters with the Academy's roster.
4. Notify the examining Committee and executive council of the status of probationers, etc.

ACTIONS TAKEN BY ACADEMY AT CHICAGO

At the recent Academy meeting in Chicago, a number of official actions were taken relating to the present and future conduct of the Academy. A summary of several of these approved actions follows:

Specialties

(a) After discussion, the Academy went on record as approving a special section devoted to the specialty of prescribing and fitting contact lenses.

(b) After discussion, the Academy went on record as approving a special section devoted to the specialty of orthoptics.

These permanent sections are to be created as standing committees which would make annual reports to the Executive Council and to the Academy at each annual meeting.

Junior Academy

After discussion, the Academy adopted the proposal of creating the Junior Academy program in our educational institutions. This program is fully reviewed elsewhere in this Journal.

Training at annual meetings

After discussion, the Academy approved the proposal that a portion of its annual meetings be devoted to a specific training program dealing with clinical subjects of technical interest to the practicing optome-

trist, these to be selected by the program committee. That during these training sessions actual demonstrations be given of the techniques involved, supplemented by a review of the background of the subject and its diagnostic or refractive significance.

Membership

After discussion, the Academy went on record empowering the Executive Council to revise the membership requirements of the Academy if advisable to do so, and report on any such action to the membership. This action contemplated a complete review of membership requirements of the Academy by the Executive Council during 1945.

Publicity at Annual Meetings

After discussion, the Academy decided that all original papers presented at its annual sessions in the future become the property of the Academy and that no publicity be released relating to the technical material contained in these papers without Academy approval. It further decided that each author prepare a brief resume of his paper to be presented to the Secretary of the Academy prior to the annual meeting for use in press releases during the Academy sessions. It further decided that any member of the Academy who failed to abide by these regulations and who entered into an individual program of press releases during a session of the Academy be subject to disciplinary action and possible expulsion from the Academy.

Annual Roster

After discussion, it was the consensus of the Academy that the Secretary annually prepare a roster containing the constitution and by-laws of the Academy; membership requirements and an alphabetical and geographical roster of all members. It was further agreed that this roster containing the names of all members of the Academy be published as of February 15 of each year.

CAREL C. KOCH.

ACADEMY COMMITTEE APPOINTMENTS

EDITORIAL COUNCIL

Dr. J. Fred Andreae, President of the American Academy of Optometry, has appointed the following members of the Academy to the Editorial Council to serve in conjunction with Dr. Carel C. Koch of the Executive Council for the year 1945: Dr. J. Fred Andreae, Dr. R. E. Bannon, Dr. H. M. Fisher, Dr. Glenn A. Fry, Dr. R. M. Hall, Dr. E. E.

Hotaling, Dr. D. G. Hummel, Dr. J. Neumueller, Dr. D. R. Paine, Dr. E. Petry, Dr. E. LeRoy Ryer, Dr. A. P. Wheelock.

PROGRAM COMMITTEE

Dr. J. Fred Andreae, President of the American Academy of Optometry, has appointed the following members of the Academy to the Program Committee to serve in conjunction with Dr. D. G. Hummel of the Executive Council for the year 1945: Dr. H. W. Hofstetter, Chairman; Dr. Glenn Fry, Dr. Julius Neumueller, Dr. J. G. Copeland, Dr. Arthur E. Hoare.

COMMITTEE ON NOMENCLATURE AND STANDARDS

Dr. J. Fred Andreae, President of the American Academy of Optometry, has appointed the following members of the Academy to the committee on Nomenclature and Standards to serve for the year 1945: Dr. Glenn Fry, Chairman; Dr. C. L. Treleaven, Dr. C. A. Radde, Dr. Rita Walsh, Dr. E. L. Higgins.

LOS ANGELES CHAPTER

DECEMBER MEETING

The regular business meeting was called to order at 5:40 P. M. by Dr. E. A. Hutchinson, President. Those present were Drs. Glenn Winslow, Harry Fuog, William Kinney, Elizabeth Wright, Orlo Weigmann, Harry Goodman, Leslie Scown, Hugo Apel, and John R. Dean, Secretary-Treasurer.

The chairman lead a discussion on requirements for eligibility for membership determined by examination, presentation of case reports and other eligibility requirements. In the discussion which followed, the requirements to be met by applicants and the evaluation of the length of time they have been in practice was covered. The recommendation for Fellowship of Dr. Robert Downs was referred to the membership committee.

After dinner the educational session was called to order by Chairman Hutchinson. Additional Fellows and guests present were Drs. Arthur Hoare, Kenneth Jaques, George McBurney, Clark Deacon, Allanzo Jessop, Olive Salter, H. C. Wright, J. Sjaardema, and Grace N. Fernald.

Fellow William Kinney made a report of the Executive Council session and the annual meeting of the Academy held recently in Chicago.

Chairman Hutchinson presented Dr. Glenn Winslow with the emblem of the Academy in recognition of his years of effort in behalf of the Academy and in appreciation of his fine work for the profession.

Dr. J. Sjaardema was called upon to present the speaker of the evening, Grace M. Fernald, Ph.D., who spoke on "Remedial Techniques of Basic School Subjects."

Following the presentation of this subject, members of the Academy were invited to visit the educational classes held daily at the Psychological Laboratory at the University of California at Los Angeles.

JOHN R. DEAN

ORGANIZATIONAL MEETING OF THE INDIANA CHAPTER

Twelve Indiana Fellows of the American Academy of Optometry met in Indianapolis, Indiana, on January 21, 1945, in connection with the 48th Annual Convention of the Indiana Association of Optometrists and organized the Indiana Chapter of the Academy.

The twelve members in attendance were: Dr. N. A. Bixler, Decatur; Dr. I. M. Borish, Kokomo; Dr. Mary Clay, Fort Wayne; Dr. J. P. Davey, Indianapolis; Dr. Dale Elson, Indianapolis; Dr. H. H. Jenner, Frankfort; Dr. Galen Kintner, Wabash; Dr. K. K. Kintner, Mishawaka; Dr. C. W. Morris, Fort Wayne; Dr. J. R. Schreve, Indianapolis; Dr. E. J. Soland, Indianapolis, and Dr. R. W. Tubesing of Richmond.

Preceding the organizational activities there was a session devoted to the interests of prospective academy members. Dr. Borish discussed the organization, objectives and ethics of the Academy and application blanks were distributed to about twenty-five of the optometrists present. The speaker at this occasion was Dr. Henry Hofstetter who gave us an interested outline of a three-quarter two credit hour course on optometric economics, ethics and jurisprudence which is being taught at the Ohio State School of Optometry in the senior year.

The organizational session resulted in the election of Dr. I. M. Borish of Kokomo as president and Dr. J. R. Schreve of Indianapolis as vice-president. Dr. C. W. Morris of Fort Wayne was elected secretary-treasurer. Drs. J. P. Davey and N. A. Bixler were elected as examiners of new applicants. The Constitution and By-Laws of the national organization were adopted and Drs. Borish, Morris and Tubesing were elected to constitute a committee to deal with problems in adapting the national constitution to the requirements of the Indiana Chapter. Dr. Borish appointed Dr. Soland as program chairman. Tht Indiana Chapter aspires to have a membership of fifty Fellows in the near future.

C. W. MORRIS